

## Computer Translation of JP 06-323159 A

### \* NOTICES \*

JPO and INPIT are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

### [Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the reciprocating engine which changed reciprocating movement of the piston into rotational movement of the output shaft.

[0002]

[Description of the Prior Art] As a reciprocating engine, a four stroke cycle engine is common, and this four stroke cycle engine, While connecting the large end of a connecting rod with the crank arm of a crankshaft, enabling free rotation, a piston is connected with the Obata part of this connecting rod, enabling free rotation, This piston is inserted into a cylinder and it has structure which formed the combustion chamber by this cylinder inside surface, the above-mentioned piston upper bed side, and the cylinder head inner surface.

[0003]

[Problem to be solved by the invention] By the way, in a reciprocating engine, it is advantageous to increase the number of times of explosion in crankshaft 1 rotation to increasing an output, and it is advantageous to make the amount of expansion work increase in explosion and an exhaust stroke. However, the above-mentioned conventional four stroke cycle engine explodes once to crankshaft 2 rotation, and two stroke cycle engines cannot explode once to crankshaft 1 rotation, and cannot increase the number of times of explosion by more than this. There is a limit also in making the amount of expansion work, etc. increase.

[0004] This invention was made in view of the above-mentioned conventional actual condition, and an object of this invention is to provide the reciprocating engine [ one explosion or more is possible to crankshaft 1 rotation and ] which can increase the amount of expansion work and which can improve output improvement and thermal efficiency.

[0005]

[Means for solving problem] The output shaft in which invention of Claim 1 was allocated pivotable, and the connecting member which adhered to this output shaft, Two or more byway guide parts which are formed in this connecting member and counter on both sides of the above-mentioned output shaft, and the guide part which has two or more major-diameter guide parts, It is a reciprocating engine in which the connecting rod in which large some parts were connected with this guide part so that relative displacement was possible, the piston by which fixed connection was carried out to the Obata part of this connecting rod, and this piston are characterized by having the above-mentioned output shaft and the cylinder slidably inserted in rectangular directions. What was really formed in the output shaft is contained in the above-mentioned connecting member.

[0006] Invention of Claim 2 is formed in the eyebrows form with which the above-mentioned guide part

has a byway guide part of a couple, and a major-diameter guide part of a couple in the reciprocating engine of above-mentioned Claim 1, It is characterized by being constituted so that the shortest distance from the above-mentioned output-shaft axis line to one byway guide part may be set up smaller than the shortest distance to the byway guide part of another side and above-mentioned one byway guide part may pass the large end of a connecting rod in explosion and an exhaust stroke.

[0007]

[Function]According to the reciprocating engine concerning invention of Claim 1, a connecting rod moves reciprocately in the direction of a cylinder shaft with reciprocating movement of a piston. And the large end of this connecting rod moves in the guide part top of a connecting member, this connecting member and by extension, an output shaft are rotated, and, thereby, reciprocating movement of a piston is changed into rotational movement of an output shaft.

[0008]And in this invention, since the guide part of the connecting member was constituted from two or more byway guide parts and two or more major-diameter guide parts, for every rotation of an output shaft, a piston strokes only the number corresponding to a byway and a major-diameter guide part, and, thereby, one explosion or more of it is attained by one rotation of an output shaft. For example, like invention of Claim 1, when the above-mentioned byway guide part and a major-diameter guide part are provided a couple every, respectively (i.e., when a byway slot and a major-diameter slot are provided every 90 degrees), it is possible for a piston to stroke four times in output-shaft 1 rotation, therefore to make it explode once for every rotation of an output shaft. For example, when a byway and a major-diameter slot are provided every 45 degrees, in output-shaft 1 rotation, 2 times explosion is possible. thus -- this invention -- the form of a guide part -- it is advantageous, when one explosion or more is possible for every output-shaft rotation and output increase is aimed at by how.

[0009]In this invention, the stroke of each distance, piston speed, etc. can be freely set up by how of the form of the above-mentioned guide part. For example, in invention of Claim 2, a byway and a major-diameter guide part are provided a couple every, respectively, Since the shortest distance to the output shaft of one byway guide part is set up smaller than the shortest distance of the byway guide part of another side and it was made for the large end of a connecting rod to pass this one byway guide part in explosion and an exhaust stroke, The stroke at the time of explosion and an exhaust stroke becomes longer than the stroke at the time of other distance, the amount of expansion work increases so much, and thermal efficiency improves.

[0010]

[Working example]The working example of this invention is described based on an accompanying drawing below. Drawing 1 - drawing 5 are the figures for explaining the star shape four stroke cycle engine by one working example of this invention, and drawing 1 is a section front view and a characteristic figure in which as for drawing 2 a section side view and drawing 3 show an explanatory view of operation, drawing 4 shows a PV diagram, and drawing 5 shows the relation between the angle of rotation of an output shaft, and a stroke.

[0011]In a figure, 1 is a star shape four-cycle 4-cylinder engine, and this engine 1, It has the crank case 2, the four cylinder blocks 3 attached to this crank case 2 at intervals of 90 degrees, the cylinder head 4 connected to this each cylinder block 3, and the cylinder-head cover 5 with which this each cylinder head 4 was equipped. The graphic display of the above-mentioned cylinder head and a cylinder-head cover is omitted about three of the four cylinder blocks 3.

[0012]The combustion crevice 4a is formed in the block side connecting face of each above-mentioned cylinder head 4, and this combustion crevice 4a constitutes the combustion chamber from the boa 3a and the piston 10 of the above-mentioned cylinder block 3. The inlet port 4b and the exhaust port 4c which carry out an opening to the above-mentioned combustion crevice 4a are drawn by the cylinder outer wall in 4 d of suction passages, and the exhaust passage 4e. The above-mentioned inlet port 4b and the exhaust port 4c are opened and closed with the inlet valve 6 and the exhaust valve 7, and the

opening-and-closing drive of this inlet valve 6 and the exhaust valve 7 is carried out with the intake cam shaft 8 and the exhaust cam axis 9.

[0013]Insertion arrangement of the above-mentioned piston 10 is slidably carried out into the cylinder bore 3a of the above-mentioned cylinder block 3. The Obata part 11a of the connecting rod 11 is really formed in this piston 10, and the large end 11b of this connecting rod 11 is connected with the connecting member 13 by which fixed connection was carried out to the output shaft 12 via the connecting mechanism 14.

[0014]The above-mentioned connecting mechanism 14 is provided with the connecting pin 16 by which insertion arrangement was carried out to the large end 11b of the above-mentioned connecting rod 11 via the needle roller 15, and the connecting-shaft carriers 17 and 18 with which the both ends of this connecting pin 16 were equipped. The projected rim 11c protrudes on the anti-piston side of the above-mentioned large end 11b. This projected rim 11c is slidably inserted into the ring groove 12a annularly cut in the above-mentioned output shaft 12, and, thereby, as for the connecting rod 11, the axial movement of the output shaft 12 is regulated.

[0015]The above-mentioned connecting member 13 comprises the disc-like left by which the placed opposite was carried out mutually, and the right plates 19 and 20. The above-mentioned left plate 19 is really formed in the above-mentioned output shaft 12, and, as for the above-mentioned right plate 20, fitting adherence of the boss section 20a is carried out at the above-mentioned output shaft 12. The guide groove 21 is annularly cut in the facing end face of the above-mentioned left and the right plates 19 and 20. Into this guide groove 21, the connecting-shaft carriers 17 and 18 of the above-mentioned connecting pin 16 are inserted so that rolling is possible. Thus, the large end 11b of the connecting rod 11 rotates the connecting member 13 and by extension, the output shaft 12 by the reciprocation moving of the piston 10.

[0016]The above-mentioned guide groove 21 is making the cocoon form which consists of the major-diameter slots 21a and 21b of the couple which counters on both sides of the above-mentioned output shaft 12, and the byway slots 21c and 21d of the couple which similarly counters on both sides of the output shaft 12. To each distance from the axis line of the above-mentioned output shaft 12 to the major-diameter slots 21a and 21b being set as  $l$ , the distance to the byway slots 21c and 21d is  $S$  and  $S'$ , and is set as  $S > S'$ . And in explosion and an exhaust stroke, the above-mentioned byway slot 21d passes the large end 11a of the above-mentioned connecting rod 11.

[0017]Next, the operation effect of this example is explained. In this example engine 1, the connecting rod 11 rotates the connecting member 13 and by extension, the output shaft 12 in connection with the axial movement of the piston 10. It explains to the cylinder of the drawing 3 upper part paying attention to this operation.

[0018]From the state (refer to drawing 3 (a)) where the piston 10 is located in a top dead center, and the connecting pin 16 of the connecting rod 11 is located in the major-diameter slot 21b of the guide groove 21 of the connecting member 13 in the suction stroke. The connecting member 13 drops the piston 10 by rotation by inertia, and the connecting pin 16 is located in the byway slot 21c of the guide groove 21. The stroke by this suction stroke is  $L-S$ .

[0019]In a compression stroke, the guide member 13 will raise the piston 10 by rotation by inertia, and the connecting pin 16 will be located in the major-diameter slot 21a of the guide groove 21. The stroke by this compression stroke is  $L-S$  as well as a suction stroke.

[0020]In a working stroke, high-pressure combustion gas drops the piston 10 from an abbreviated upper dead point position to a bottom dead point position, and the connecting pin 16 of the connecting rod 11 is located in the byway slot 21d. The stroke by this working stroke is  $L-S'$ , and is larger [ the part to which  $S'$  is set smaller than  $S$  ] than the stroke by the above-mentioned inhalation and compression stroke.

[0021]In an exhaust stroke, only the stroke same to a top dead center as the above-mentioned working stroke raises the piston 10 by rotation according [ the guide member 13 ] to the inertia of the output

shaft 12.

[0022]Thus, since the major-diameter slots 21a and 21b of a couple and the byway slots 21c and 21d of the couple constituted the guide groove 21 of the connecting member 13 from this example engine 1, The piston 10 will carry out about four lines per rotation of the output shaft 12, it becomes possible to explode once for every rotation of the output shaft 12, and output increase can be aimed at. It ends with one half of revolving speed to obtain the same output, and friction loss, pumping loss, etc. can be reduced.

[0023]In this example, since the distance from the axis line of the output shaft 12 to the byway slot 21d of explosion and an exhaust side was set up smaller than the distance to the byway slot 21c by the side of inhalation / compression, the stroke at the time of explosion and exhaust air becomes larger than stroke L-S at the time of L-S', and inhalation and compression (refer to drawing 5). As a result, the amount of expansion work becomes large by the field shown in drawing 4 with a slash, and thermal efficiency can be improved.

[0024]In this example, since the piston and the connecting rod were fixed, for both, it moves only in the direction of a cylinder shaft, and is hard to produce for the first time in [ of a piston / a head ], and, as a result, the action of a piston is stabilized, and they can reduce the amount of blow-by gas, and lubricating oil consumption.

[0025]By this example, since four cylinders were combined with the cross-joint form, vibration can be negated mutually and can be used as a quiet engine further again.

[0026]Although the above-mentioned working example explained the case where a guide groove consisted of a byway slot of a couple, and a major-diameter slot of a couple, the form of a guide groove is not limited to this and may form a byway slot and a major-diameter slot every 45 degrees, for example. When it does in this way, a piston will stroke one time with 45 rotations of an output shaft, and 2 times explosion can be performed for every output-shaft rotation.

[0027]Although explosion / exhaust air stroke was made larger than inhalation and a compression stroke with the form of the guide groove in the above-mentioned working example, the form of a guide part is suitably set up in this invention.

Therefore, further various kinds of engine characteristics are realizable.

For example, in an intake stroke, by an inlet valve's beginning to open and raising a neighboring piston speed, the air flow rate into a suction passage is sped up, and suction efficiency can be improved. In a compression stroke, it is also possible by changing slowly the piston climbing speed near the top dead center to control the rise of the air temperature by rapid compression, to lower the temperature before ignition relatively, and to prevent generating of a knock.

[0028]Drawing 6 - drawing 8 are the examples which made the volume change to the crank angle at the time of combustion looser in the working stroke than in the conventional reciprocating engine by setting up the above-mentioned guide groove form suitably. In this example, as shown in drawing 6, the bulged part 21e was formed in the portion corresponding to the working stroke of the guide groove 21. As this shows drawing 7 and drawing 8, the amount of expansion work in a working stroke increases, and thermal efficiency improves.

[0029]Although the above-mentioned working example explained the four stroke cycle engine, of course, this invention is applicable also to two stroke cycle engines. Furthermore, this invention is applicable not only to a reciprocating engine but a reciprocating type compressor.

[0030]

[Effect of the Invention]Since the guide part of the connecting member was constituted from two or more byway guide parts and two or more major-diameter guide parts according to the reciprocating engine applied to invention of Claim 1 as mentioned above, It is effective in one explosion or more being attained for every rotation of an output shaft, and being able to aim at output increase, or being able to make an engine speed low to the same output.

[0031]In this invention, the stroke of each distance, piston speed, etc. can be freely set up by how of the form of the above-mentioned guide part. For example, in invention of Claim 2, since the shortest distance to the output shaft of one byway slot was set up smaller than the shortest distance of the byway slot of another side, the stroke at the time of explosion and an exhaust stroke can be made longer than the stroke at the time of other distance, and there is an effect which increases the amount of expansion work so much, and can improve thermal efficiency.

---

[Translation done.]

---

## CLAIMS

---

[Claim(s)]

[Claim 1]A reciprocating engine comprising:

An output shaft allocated pivotable.

A connecting member which adhered to this output shaft.

Two or more byway guide parts which are formed in this connecting member and counter on both sides of the above-mentioned output shaft, and a guide part which has two or more major-diameter guide parts.

A connecting rod in which a large end was connected with this guide part so that relative displacement was possible, a piston by which fixed connection was carried out to the Obata part of this connecting rod, and a cylinder in which this piston was slidably inserted in the above-mentioned output shaft and rectangular directions.

[Claim 2]The above-mentioned guide part is formed in a cocoon type which has a byway guide part of a couple, and a major-diameter guide part of a couple in Claim 1, A reciprocating engine constituting so that the shortest distance from the above-mentioned output-shaft axis line to one byway guide part may be set up smaller than the shortest distance to a byway guide part of another side and above-mentioned one byway guide part may pass a large end of a connecting rod in explosion and an exhaust stroke.

---

[Translation done.]

---

## DESCRIPTION OF DRAWINGS

---

[Brief Description of the Drawings]

[Drawing 1] It is a section front view of the reciprocating engine by Claim 1 and one working example of invention of 2.

[Drawing 2] It is a section side view of the above-mentioned working-example engine.

[Drawing 3] It is a mimetic diagram for explaining operation of the above-mentioned working-example engine.

[Drawing 4] It is a P-V diagram for explaining the effect of the above-mentioned working-example engine.

[Drawing 5] It is a characteristic figure showing the relation between the output-shaft angle of rotation for explaining operation for the effect of the above-mentioned working-example engine, and a stroke.

[Drawing 6] It is a mimetic diagram showing the guide groove of the modification of the above-mentioned working example.

[Drawing 7] It is a characteristic figure showing the relation between the output-shaft angle of rotation of explanation \*\*\*\*\*, and a stroke for operation of the above-mentioned modification.

[Drawing 8] It is a P-V diagram for explaining the effect of the above-mentioned modification.

[Explanations of letters or numerals]

1 Reciprocating engine

4 Cylinder

10 Piston

11 Connecting rod

12 Output shaft

13 Cam board

21 Guide groove

21a and 21b Major-diameter slot

21c The byway slot of another side

21 d One byway slot

The shortest distance to the byway slot of S another side

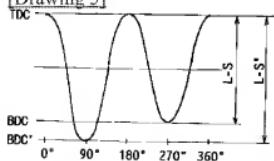
S' The shortest distance to one byway slot

---

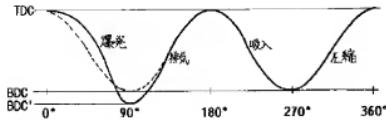
## DRAWINGS

---

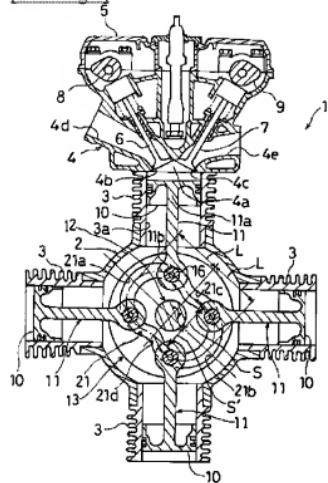
[Drawing 5]



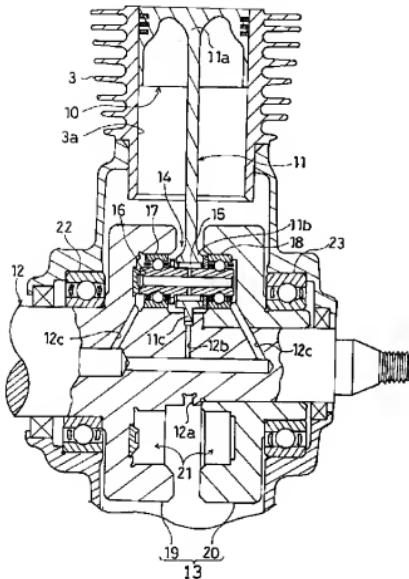
[Drawing 7]



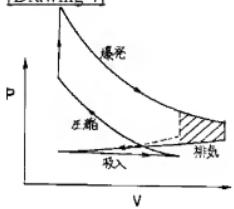
[Drawing 1]



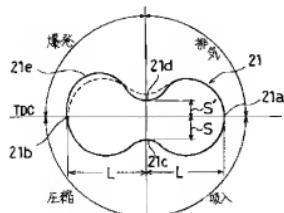
[Drawing 2]



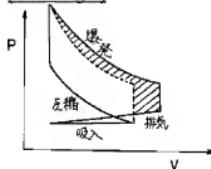
[Drawing 4]



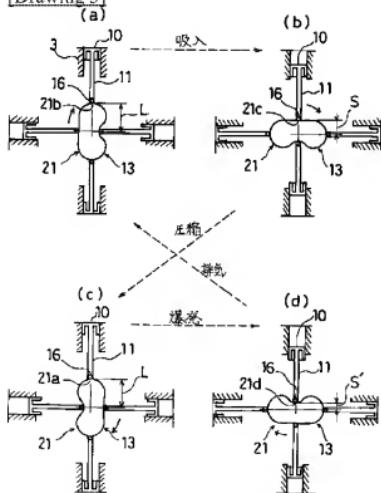
[Drawing 6]



[Drawing 8]



[Drawing 3]



[Translation done.]